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Summary Report of

Utilization Research and Development

Fiscal year 1963

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**Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE**

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UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

SUMMARY REPORT OF UTILIZATION RESEARCH AND DEVELOPMENT

Fiscal Year 1963

I NATURE AND OPERATION OF UTILIZATION RESEARCH

Objectives

Utilization research aimed at expansion of agricultural markets and reduction of processing and distribution costs can:

1. Increase farm income
2. Reduce Government costs of farm programs
3. Reduce burdensome carryover of farm commodities
4. Increase consumers' welfare

Research Approaches

1. Expand markets for animal products
2. Devise less costly, more attractive, and more nutritious foods
3. Increase industrial uses for agricultural commodities
4. Develop products for export where sales are responsive to price and quality

The Department's utilization research investigations are conducted primarily in Federal facilities consisting of four regional laboratories and ten field stations in the United States. Research is done also through contracts and memoranda of understanding with State Experiment Stations, universities, and industry. Other supporting research is accomplished in research institutions of sixteen countries in Europe, Asia, and South America through funds generated by the P. L. 480 program (Agricultural Trade and Development and Assistance Act of 1954, 83rd Congress, 2nd Session).

II DISSEMINATING UTILIZATION RESEARCH INFORMATION

The research knowledge generated by the Utilization Research and Development program is made available for public benefit by as many means as time and resources permit. Principal channels and breadth of disseminating such information are illustrated in the following typical ways for F.Y. 1963:

| | |
|-------|---|
| 79 | patents obtained |
| 688 | research papers published |
| 682 | speeches, press releases, and appearances on radio and television |
| 52 | formal conferences with industry |
| 38 | public-service exhibits |
| 5,000 | technical visitors to UR&D installations |

The selected examples given below illustrate the types of activities pursued to maximize adoption of UR&D discoveries by American industry and consumers.

Rural Areas Development

Near the end of the fiscal year there was instituted in the Product and Process Evaluation Staff a program cooperative with the Office of Rural Areas Development and other Department and State agencies designed to bring developments of utilization research to the attention of rural community leaders. It is designed to describe in detail those developments that have been applied with success and to counsel from the viewpoint of the community regarding their potential for success under existing conditions.

Special Exhibits and Films

Three 16-mm color films were completed and distributed for use in F. Y. 1963:

1. "Target Zero" (20 min.)--Effects of time-temperature factors on frozen food quality (informational and educational)
2. "Removal of Strontium-90 from Milk" (19 min.) -- Needs for and method for removing radioactive strontium-90 from milk. (Informational and educational for industry.) (Note: a 3½ min. excerpt was prepared for other TV use)
3. "Challenging Careers" (23½ min.)--Opportunities in agricultural research for scientific and related personnel (for recruiting purposes)

Construction of a series of six exhibits, each portraying a specific UR&D accomplishment, was completed during F. Y. 1963. These exhibits* are being shown before groups interested in the USDA program. Two additional exhibits ("New and Improved Soybean Products" and "Improved Cottonseed Products") are in preparation. (*"Bulgur -- Ancient Wheat Food Modernized by Utilization Research"; "Better Leather through Utilization Research"; "New Industrial Uses for Animal Fats"; and "New Cereal Pulp Products for Paper.")

The Western Utilization Research and Development Division put on exhibits depicting the WURLAN treatment to impart shrink-resistance to wool fabric at the California State Fair; the County Fairs of Alameda, Contra Costa, and Kern Counties; National Meeting of the American Association of Textile Chemists and Colorists (Atlanta, Georgia); and the Oakland Public Museum; the California Hand Weavers Association (San Francisco); and the California Polytechnic Institute (San Luis Obispo).

A Southern Utilization Research and Development Division exhibit showing new SU-developed chemical finishes for cotton, including stretch cottons and the newest wash-wear finishes, has been shown before the National Meeting of American Association of Textile Chemists and Colorists (Atlanta, Georgia), the Cotton Utilization Conference (New Orleans, Louisiana), and Howard University (Washington, D. C.).

The Northern Utilization Research and Development Division participated in a Federal, State, and County Agricultural exhibit depicting past-to-present development of agriculture production and utilization at the "Heart of Illinois Fair" (Peoria, Illinois).

As a part of a recruitment program for scientific personnel at one of the senior colleges, the Eastern Utilization Research and Development Division presented an exhibit showing basic research on proteins, showed the ARS film "Challenging Careers," and distributed booklets giving objectives, describing facilities, and outlining selected accomplishments of the EURD research program.

Examples of Formal Conferences with Other Organizations

Wheat Utilization Conference. During the week of October 29, 1962, the Northern and Western Divisions of ARS and the National Association of Wheat Growers jointly sponsored the First National Conference on Wheat Utilization Research. This meeting, held in Lincoln, Nebraska, and attended by over a hundred, emphasized the research and development work on cereal pulps, gluten structure, and chemical modification of wheat flour.

Sixth Milk Concentrates Conference. On April 16 and 17, 1963, the Eastern Division, University of California, the Evaporated Milk Association, and the American Dry Milk Institute, jointly sponsored technical

sessions devoted to the proteins of milk, the physical stability of concentrated milk products, and the flavor and stability of concentrated milk products. These annual conferences have contributed much to the planning of basic research and application of basic findings to practical needs of the dairy industry.

Conference on Producing a Biological Pesticide for Control of Japanese Beetle. Some 20 representatives from the University of Illinois, Cornell University, Michigan State University, and USDA's Entomology Research Division, Plant Pest Control Division, and the Northern Division, jointly discussed problems relevant to the production and use of spores of the milky disease bacteria (Bacillus popilliae) determined to be an effective means for controlling the Japanese beetle. Results stemming from this joint conference, held Nov. 15 - 16, 1962, included important progress on propagation, chemistry, infectivity and sporulation.

Cotton Batting Research Lauded at Conference. The Executive Committee on Cotton Batting Research -- representing the National Cotton Council, National Cotton Batting Institute, National Cottonseed Products Association, and the Textile Waste Association -- commended the Southern Division on the basic and practical progress made in developing superior cotton batting. This joint meeting, held September 26, 1962, was attended by manufacturers of batting, bedding and furniture, and equipment for use in the batting industry.

Collaborators Conference on Flavor and Texture of Foods. Approximately 100 people from 20 states and 3 foreign countries attended a 2-day meeting (October 29 and 30, 1963) -- at the Eastern Division -- devoted to the chemistry and related factors of flavor and texture of foods.

The Spring Starch Round Table. The 14th meeting between the Technical Committee of the Corn Industries Research Foundation and ARS representatives was held at the Northern Division in June 1963. Basic research on the chemistry and physics of starch derivatives of cereal grains was the principal theme.

Maple Industry Conference. The Fifth Triennial Maple Industry conference was held at the Eastern Division on October 23 and 24, 1962, and attended by over 100 producers of maple sirup and specialists in this field from government, academic and commercial institutions representing 13 states and 2 provinces of Canada. In that same week a 1-day meeting (Third Annual Meeting) of the National Maple Sirup Council developed technical and marketing information of particular interest to 8 major sirup producing states.

The Science of Seed Proteins. What is believed to be the first World's conference devoted exclusively to fundamental studies of seed proteins was held at the Southern Division on January 23, 24 and 25, 1963.

Discussions stressed the role of seed proteins in human and animal nutrition. Approximately 80 scientists from among the leading seed protein researchers attended the conference, representing both American and foreign workers in this field. These joint considerations will do much to foster a better continuing exchange of scientific knowledge in the field of seed proteins and will encourage better nutritional practices throughout the world.

Meeting of Southern Agricultural Experiment Station Collaborators. A two-day meeting (March 1963) was held at the Southern Division with representatives of the Southern Agricultural Experiment Stations and industry to discuss basic research related to advances in flavor research. The discussions covered all types of food -- especially emphasizing fruits, vegetables, meat, dairy and pre-cooked, prepared foods.

Citrus Research Conference. Over 100 persons attended the annual Citrus Research Conference held December 4, 1962 at the Pasadena Fruit and Vegetable Laboratory (Western Division). Of particular interest to the research representatives of industry and government laboratories were the discussions on trace constituents, flavor improving processes, and the status of the WU-developed foam mat drying process.

Sixth Dry Bean Research Conference. This conference, held in Los Angeles in January 1963, covered a wide range of both basic and applied research on dried beans. The Experiment Stations of California, New York and Michigan, the Idaho Bean Commission, the Illinois and Stanford Universities, the National Dry Bean Council, the California Lima Bean Advisory Board, and members of USDA Western Division discussed the various phases of research and development currently being undertaken in the dry bean industry. Through such exchange of ideas, a better understanding is being attained concerning the real problem areas yet to be solved.

Dry Fruit Industry Meeting. In January 1963 the Executive Committee of the Dried Fruit Association discussed jointly with the Western Division the research being done to improve products and processing of dried fruits. The purpose of such interchange is to couple basic research and technological developments with the practical marketing needs, with special emphasis directed to problems of export consumers.

Sugar Beet Processing Conference. A 14-man sugar beet process advisory committee met with the Western Division researchers on May 24, 1963, to review sugar beet research and to outline urgent needs of the industry. Through these periodic conferences (this was the 16th meeting) the ARS research program on sugar beets is kept current of the changing industrial needs; conversely, sugar beet processors are enabled to take early advantage of the latest scientific findings.

Oil Seed Collaborators Conference. Another periodic meeting was held in June 1963 between the oil seed research staff of the Western Division and representatives of the industry and certain universities. This meeting was devoted to discussions of the problems of castor seed processing -- study of allergenic factors, castor meal improvement, and the chemistry of castor oils.

III COOPERATIVE RESEARCH WITH OTHER ORGANIZATIONS

Cooperative research with outside scientific groups -- industry, State Experiment Stations, academic institutions, and other Federal Agencies -- assures sound evaluation of newly-developed products and processes, keeps a sharp focus on new needs of consumers, and offers a rich source of ideas for solving research problems. Typical examples of such cooperative efforts are given below.

Examples of Cooperative Research and Development

| Project | Cooperators with USDA UR&D |
|--|---|
| Wurlan treatment (easy-care) of wool top and fabrics | : Majority of commercial wool textile processors |
| New food products from wheat ("instant" bulgur, "peeled" wheat, etc.) | : Farmers Cooperative Commission : Kansas Wheat Commission |
| Commercialization of water-soluble gums from corn sugar | : Pilot-plant work with four industrial manufacturers |
| Potato processing research (varietal and other processing characteristics) | : Red River Valley Potato Growers Association, U. of Minnesota, and N. Dakota State University |
| Dried fruit products (high-moisture processing; improved baking adjuncts) | : Cal. Raisin Advisory Board, Dried Fig Advisory Board, Prune Advisory Board and Dried Fruit Association |
| Citrus powders by new foam-mat drying process | : Florida Citrus Commission |
| Intumescent fire-retardant coatings | : U. S. Army Engineers and Pan American Tung Res. & Dev. League |
| Radiation preservation of poultry meat | : Q.M. Research & Engineering Command |
| Compositional studies of tobacco and tobacco smoke | : Cigar Manufacturers Assn. of America |
| Market testing of pre-cooked sweetpotato flakes | : Economic Research Service (USDA), La. Sweet Potato Comm., La. Agr. Exp. Station; La. State Dept. of Agr., Owen-Ill. Glass Co., Continental Can Co., Lengersfeld Bros. |
| New food products for civilian defense fallout shelters | : Department of Defense, Oregon State University |

IV PROGRAM MODIFICATION TO MEET CHANGING NEEDS

Planning

Utilization research planning is a continuously changing pattern of finding efficient ways to convert imaginative ideas to tangible, economic products and processes through coordinated scientific studies. This research planning has the benefit of the advice and cooperation of many organizations and individuals both within and outside the Department of Agriculture.

Committee on Agricultural Science. A 15-member advisory group of outstanding professional personnel -- consisting of 10 chemical and biological scientists and 5 economists -- reviews, evaluates, and makes recommendations concerning USDA research in related basic sciences.

USDA National and Agricultural Research Advisory Committee. An advisory committee composed of 11 members, with broad national interests in all phases of agriculture, evaluates the Department's entire research program and offers suggestions -- with emphasis on policy matters -- for modifications, additions, and deletions.

Commodity and Functional Advisory Committees. The Commodity and Functional Advisory Committees, authorized under the Research and Marketing Act of 1946, and recently numbering 24, have been realigned during F. Y. 1963 to assure more effective communication with the many organizations interested in agricultural research. The new alignment provides for 11 public and industry research and marketing advisory committees as follows:

1. Farm Resources Research
2. Utilization Research and Development
3. Human Nutrition and Consumer Use Research
4. Marketing Research and Service
5. Agricultural Economics Research
6. Forestry Research
7. Animal and Animal Products Research
8. Cotton and Tobacco Research
9. Grain and Forage Crops Research
10. Horticultural Crops Research
11. Oilseed, Peanut and Sugar Crops Research

Product and Process Evaluation Staff. A permanent staff group of the Administrator's Office, ARS, composed of scientists, engineers, and economists, assists in evaluating the commercial feasibility and general appropriateness of proposed utilization research projects.

State Agricultural Experiment Stations. The Directors and designated technical collaborators of the State Agricultural Experiment Stations, in the respective four national regions, assist in planning research activities of mutual interest to the Federal and State groups.

Agricultural Trade Associations. Recognized national and regional groups of growers, processors, handlers, carriers, and distributors are constant sources of advice on broad needs as well as concerning problems of immediate urgency.

Industry Groups. Advice is sought, and technical and related information exchanged, from all segments of the agricultural industry -- growers, shippers, processors, and distributors -- concerning the many problems of profitably converting agricultural commodities to newer and broader uses.

Special Consultants. Experts retained on a "when actually employed" basis, who are recognized authorities in particular fields of interest, give technical and economic advice to assist in program planning and evaluation.

Consumer Groups. Representative consumer groups of national and regional scope supply guidelines for research planning through their evaluations of product performance and indications of product needs. The Economic Research Service and the Agricultural Marketing Service of USDA give particular assistance through market studies, information on market trends, and consumer evaluation of new UR-developed products and processes.

Program Dynamics

The Utilization Research and Development program is continuously appraised and reviewed (1) to determine fruitfulness of the research efforts, (2) to discontinue investigations that have reached the point of optimum return or appear unrewarding of useful results, and (3) to intensify research, either by reduction of effort on projects of lesser importance or by new resources when available, in areas showing substantial promise and to direct research efforts to meet new needs. Examples of such redirection of research efforts are given below:

With the successful completion of research projects on development of wash-wear cotton fabrics and garments with durable creases and shapeholding properties, and on development of wash-wear cotton fabrics by controlled reaction with formaldehyde, personnel were reassigned to important new research involving investigations of finishing treatments to produce wash-wear cotton stretch fabrics with improved strength, drape, and hand.

Exploratory research on the crosslinking of cotton cellulose with difunctional etherifying agents using alkaline catalysts was successfully completed, and personnel reassigned to initiate research on the separation and identification of the cleavage products of partially etherified cottons, including crosslinked cottons, as a possible basis for elucidating the chemical structure of the modified celluloses.

Exploratory studies of the etherification of cellulose using radioactively labeled reagents were terminated so that the personnel released could be utilized on higher priority research on the preparation of cotton products containing radiation-induced polymers possessing desirable physical properties.

Completion of basic research on isolation and characterization of flavor and odor constituents of celery made resources available to initiate research to apply this new basic information to the development of processed celery products of improved flavor and convenience.

Increased emphasis was placed on the preparation and evaluation of improved polyester resins from pine gum derivatives by transferring personnel from basic studies on isolation and characterization of some major unidentified components in pine gum and its derivatives.

Increased emphasis on investigation of the effect of metal ions and metal ion complexes on the autoxidation of emulsified fats was made possible by transferring scientists from work on methods for the fractionation and determination of the constituents of animal fats and their degradation products.

Increased emphasis was placed on basic studies of potato composition, through the transfer of scientists from completed work on identification of inhibitors for pectinolytic and cellulolytic enzymes, to basic studies on the potato lipid fraction.

Increased emphasis was placed on quality improvement in maple products by fermentation-induced biochemical reactions through transfer of scientists from completed exploratory work on microbial fermentation of sap and selective screening for desirable organisms.

Research was begun on the development of methods for the preparation of anhydrous milk fat (butter oil) with better flavor and stability; personnel were reassigned to this undertaking from completed research on the preservation of milk fat in the form of a sweetened cream product.

Increased emphasis was placed on the development of a process for the mass production of spore dust for use as a biological insecticide by growing on a cereal grain media bacteria that are pathogenic to Japanese beetles by release of personnel on completion of work on screening microorganisms for the production of insect toxicants, repellents, and attractants.

Work on the conversion of dialdehyde starch to low-molecular-weight chemical products was completed and personnel were transferred to studies on cereal xanthates for use in paper.

Exploratory studies on fermentative modification of soybean and linseed oils were discontinued and resources were used to expand basic studies on constituents in soybeans important to their use in foreign-type foods for increasing export outlets.

Laboratory studies on cyclic fatty acids from linseed and soybean oils were completed and personnel reassigned to basic studies on new products obtained by reacting ethylene with these oils.

Successful completion of studies aimed at the development of new parboiled wheat food products and at the development of a simple continuous process for commercial production of bulgur at atmospheric pressure, have released resources for further work in the area of development of new wheat foods.

In view of the availability of a commercial, effective drosophila attractant, work on the development of this type of insect attractant has been discontinued, thereby releasing resources to initiate research on product and process developments of tropical fruits.

Successful completion of studies on the biochemistry of sulfur-containing flavor constituents of vegetables, including the development of techniques for isolating and characterizing sulfur-containing components of onions, has released funds for more advanced studies on the chemistry and enzymology of the flavor-bearing components of other vegetables.

Utilization Research Projects Terminated

A total of 63 domestic research projects were terminated in F. Y. 1963 for the following reasons.

| | |
|--|-----------|
| Research objectives attained | 42 |
| Research objectives partially attained | 8 |
| Research results unpromising or superseded by research of higher priority | 3 |
| Exploratory research to guide future work | <u>10</u> |
| Total terminated | 63 |

Five foreign research projects (under P. L. 480) were terminated during the same period.

Utilization Research Projects Initiated or Revised

One hundred eighty-nine utilization research projects were initiated or revised in F. Y. 1963; a substantial part of this increased number was for initiating or expanding work authorized by the \$4.975 million F.Y. 1963 increase. Of these 189, new domestic projects totaled 152, with 37 new projects being placed in foreign laboratories.

| COMMODITY | INDUSTRIAL USES | | FOOD USES | | FEED USES | | TOTAL | |
|---|---------------------|-------------|--------------|-------------|--------------|-------------|-------------|-------------|
| | <u>1/</u> <u>2/</u> | | | | | | | |
| | <u>Dom.</u> | <u>For.</u> | <u>Dom.</u> | <u>For.</u> | <u>Dom.</u> | <u>For.</u> | <u>Dom.</u> | <u>For.</u> |
| Cereal grains and forages | 19 | 2 | 11 | 2 | 3 | 2 | 33 | 6 |
| Cotton and wool | 35 | 4 | -- | -- | -- | -- | 35 | 4 |
| Fruits and vegetables | -- | -- | 21 | 3 | -- | -- | 21 | 3 |
| Oilseeds | 6 | 5 | 10 | 6 | 4 | 2 | 20 | 13 |
| New and special crops | 7 | 1 | 1 | 1 | -- | 1 | 8 | 3 |
| Poultry, dairy and animal products ... | 7 | 1 | 28 | 7 | -- | -- | 35 | 8 |
| | 74 | 13 | 71 | 19 | 7 | 5 | 152 | 37 |

1/ Domestic

2/ Foreign

Summary of Utilization Research Projects for F. Y. 1963

| Type | Active at Beginning F. Y. 1963 | Initiated or Revised | Terminated | Active at End F. Y. 1963 |
|----------|--------------------------------------|----------------------------|------------|--------------------------------|
| Domestic | 306 | 152 | 63 | 395* |
| Foreign | 110 | 37 | 5 | 142 |
| Total | 416 | 189 | 68 | 537 |

* Includes 33 projects directly supported by industry (fellowships), 103 domestic contract projects, and 6 projects supported by funds transferred from other Federal Agencies.

New Research Initiated with Increased Appropriations

Additional research was made possible by an increase of \$4,975,000 in appropriated funds in F. Y. 1963.

Cereal and Forage Crops

Research directed toward development of a process for the mass production of spore dust for use as a biological insecticide by growing bacteria that are pathogenic to Japanese beetles on cereal grain media was greatly expanded through basic research studies under contracts at four universities.

Studies on grafting petrochemicals to cereal starches to produce new products were expanded by a contract with a research institute.

Both applied and basic studies on development of cereal xanthides for use in paper and paper products were expanded by a new project and by a contract with a research institute.

Studies were initiated on processes to reduce microbial contamination of wheat flour for use in frozen and refrigerated baked products, and on development of new fermented wheat foods for increasing export markets for U. S. wheat, especially in the Orient.

Basic research on the chemistry of cereal grain products was expanded by a new project and by a contract with a university.

In order to determine the reasons for the greater response of winter wheat flours to maturing agents, the differences in the proteins and lipids of hard red spring and hard red winter wheat are being studied through contract research.

Additional effort was directed to the evaluation of differences in flour behavior resulting from differences in their lipid compositions and lipoprotein characteristics.

Studies were initiated to determine how maturing of flour influences specific chemical groups and to obtain information on the mechanisms by which bread flour baking properties are improved by maturation.

Work by contract was started which will use radioactive isotopes to study how individual wheat proteins or groups of closely related proteins influence the qualities of bread dough.

Completion of studies on the protection of carotenoids in dehydrated alfalfa by mixtures of ethoxyquin and aliphatic amine synergists have demonstrated that interactions of lipids are important in mechanisms of

protection, and that there is not sufficient information available on the nature of alfalfa lipids. In order to provide this information, new basic studies, under contract, were initiated on the characterization of alfalfa lipids.

Work directed at developing improved processed forage products by taking advantage of natural growth factors present in several legume forages has been considerably expanded.

Cotton, Wool and Other Fibers

Studies have been greatly expanded on the interrelationship between the mechanical and physical properties of wool fibers, and the properties of modified fibers and fiber assemblages, as a basis for improving ease-of-care performance.

The chemical modification program, which resulted in the development of interfacial polymerization as a means of imparting shrink resistance to wool, was considerably expanded by studies on several additional classes of polymers other than the presently used polyamides.

Studies are now underway on the application of the interfacial polymerization treatment of wool top. These new studies are also being strengthened with resources released by successful completion of studies on the setting and relaxation of wool fibers in fabrics.

Contract studies have been initiated on an investigation of the basic variables which determine wrinkle performance of light-weight wool fabrics in order to develop fabrics with high wrinkle recovery properties.

Research was intensified on the development of cotton knit fabric having increased bulk, warmth, and dimensional stability.

The determination of the structural components of the cotton fiber that contribute most to tensile strength and how they can be utilized to increase tensile and recovery properties to produce cotton products having enhanced physical properties are being investigated through contract research.

Research was instituted on the development of test methods for stretch cotton textiles for use as a guide in producing better cotton stretch yarns and fabrics.

Studies of the effects of gross and fine structures of the cotton fibers on their physical behaviors are being intensified.

The aerodynamic separation of lint cotton into individualized fibers to provide information needed for improving cotton textile processing equipment is being conducted through contract research.

Outside contract work has been undertaken on the development of improved weather-resistant, water-repellent finishes for cotton.

Contract studies were started on additional microscopical investigations of absorption phenomena in native, mercerized, and modified cottons to elucidate phenomena associated with swelling of fibers in various liquid media.

The crosslinking of various physically modified crystalline forms of cotton as a means of producing resilient cotton textiles having improved appearance and durability to wearing are being studied more intensively under expanded work.

Greater efforts are being put on studies of removal of short fibers from cotton by the development of a prototype machine.

Improvement in the bulk resilience and cohesion of cotton batts as a means of enhancing cotton's competitive position in this market is being accelerated.

Additional work was put on the development of stretchable-type cotton yarns and fabrics that will successfully compete with fabrics made from synthetic fibers and blends of synthetic fibers for clothing, household and industrial uses.

The development of chemical and mechanical treatment of stretchable cotton yarns suitable for weaving and knitting into fabrics with enhanced qualities is being given greater emphasis.

Additional efforts are being placed on studies to determine the relative effect of fiber properties on both yarn properties and spinning performance to utilize cottons more efficiently.

Fruits and Vegetables

Composition studies are now underway on desert grapefruit and grapefruit products, particularly from the point of view of solving some of the problems involved in grapefruit bitterness.

An investigation under a grant has been started to provide basic information on the formation and physical structure of fruit tissue cell walls.

Studies are being undertaken to develop new and improved products from viniferous grapes, especially of the Thompson seedless variety.

Novel methods -- including a combined sublimation and evaporation process for dehydrating, vacuum freeze-drying, and atmospheric freeze drying -- for the production of new and improved dehydrated piece-form fruit products are being explored.

Studies have been started, by contract, to acquire basic information on the mechanism of the movement of water in and out of cells in order to provide a better basis for the improvement of dehydration, dehydro-freezing, and reconstitution of vegetable products.

An increased program was undertaken on the compositional and structural factors which influence flavor and texture of dehydrated potato products.

Work was initiated on the volatile flavor components of tomatoes to provide information needed for the production of high quality concentrated and dehydrated tomato products.

Research has been expanded on the biochemical mechanism of the conversion of precursors to carotenoids in grapefruit, as a basis for improvement of processing characteristics of and products from colored grapefruit.

Work was increased on the development of improved fruit juice blends, drinks, and concentrates.

Investigations have been initiated on the foam-mat drying of concentrated grapefruit juices to provide a new grapefruit product of optimum flavor and high stability.

Development of new and improved processed products from southern grown vegetables was expanded.

Investigation of the flavor and aroma components in natural and pure culture fermented cucumber pickle products has been expanded.

Oilseeds

Basic studies on increasing the flavor stability of edible soybean oil were expanded by contracts with two universities and by a USDA project.

Studies on high-protein soy food products to increase the use of soybeans in foreign markets were expanded.

Investigations on new protective coatings from soybean and linseed oils were undertaken by contract at a university and by studies under a revised project.

Through contract research, chemical investigations of cyclopropanoids are being extended to develop means of eliminating or physiologically inactivating these deleterious constituents of cottonseed and certain of its products.

Work was initiated to study the proteins and non-glyceride lipid-soluble constituents of peanuts and processed peanut products to expand their utilization.

Investigations were initiated on the development of hydrogenation techniques which will produce the least possible isomerization in edible fat products prepared from cottonseed oil and peanut oil.

Investigations were started to isolate and identify the factors in cottonseed meal that cause mortalities among swine, in order to develop cottonseed meals that can be used without restriction in feeding to nonruminants.

Pilot-plant development of a cottonseed extraction process using hexane-acetone-water solvent mixtures to a stage suitable for commercial evaluation were extended.

Studies have been initiated to investigate methods and equipment suitable for large-scale industrial processing of castor pomace in order to successfully deallergenize this product.

Studies (contract) have been started to provide information useful in the development of superior protective coatings which contain hydroxy-unsaturated oils and their derivatives.

New and Special Plants

Chemical screening of uncultivated plants in search of new crops was expanded.

Investigations on developing Crambe abyssinica into a new oilseed crop that is noncompetitive with present commercial oilseed crops were expanded.

Basic compositional studies of tobacco smoke and other substances were expanded as a basis to improve the quality and extend the utilization of tobacco.

Poultry, Dairy and Animal Products

Under a research contract, a histochemical study of components of meat connective tissue was begun to determine their relation to tenderness and ways to modify these components to improve the utilization of lower-grade meats.

A comprehensive study was begun, under a research contract, of fungi associated with meat processing and flavor development in order to develop new products of distinctive flavor characteristics.

Research was begun, under a contract, jointly supported by the Department and the U. S. Public Health Service, for the development of systems for a commercial-scale process for removal of radioactive contamination from fluid milk.

Research was started, through a research grant, on the alteration of the inorganic colloidal calcium phosphate complex to increase protein stability as a key to improving evaporated milk.

Basic studies of milk components were expanded by investigations of the interactions of milk proteins in solution.

Microbiological studies of milk were expanded with studies of the physical or chemical influences which promote or inhibit the transformation of bacterial spores from the heat-stable to the heat-labile condition and investigation of the biochemical properties of spores and vegetative cells of bacteria.

Studies were begun on stale flavor development in sterile milk and the production of reversible sol-gel transformations in high-solids sterile concentrates, as part of a continuing effort to develop a sterile milk concentrate of beverage quality.

Studies were expanded on preparation of long-chain products from epoxidized and hydroxylated derivatives of inedible animal fats, for use in the external and internal modification of polymers, and on the preparation, polymerization, and copolymerization of polymerizable amides from animal fats.

Investigations were expanded on soap-detergent combinations based on inedible animal fats.

Studies were begun on the physical properties of collagen and leathers to obtain basic information for use in developing products with improved service performance and utility to enhance leather's competitive position with substitutes.

Investigation of the chemical modification of hide proteins was begun involving introduction of new and additional reactive sites for increasing the tanning and binding capacity in order to develop new and improved products that will create new markets for animal hides.

Studies were expanded on chemical and microbiological factors involved in the processing and storage of meats, including chemical, physical and biological factors involved in the development of oxidative rancidity in fats, fatty tissues and meats.

Research was intensified on improving the quality of meat and meat products through studies on the recovery and identification of the substances responsible for the flavor and aroma of meat.

Basic studies were extended on chemical reactions involved in meat curing, and work was begun on improving smoked meat products by identifying the substances present in wood smoke that either directly or through reactions contribute to the flavor and aroma of smoked meat.

Basic studies of meat microbiology were expanded through studies of microorganisms capable of growth near 0° C., with particular emphasis on their nutrition and enzymatic activity.

Basic investigations of meat were extended by studies of the physical and chemical characteristics of meat needed in developing improved methods of meat processing, including meat protein composition and distribution in relation to tenderness and juiciness.

Study was begun on development of new or improved meat processing methods, and of new meat products.

Methods are being examined, by contract research, for freeing eggs and egg products of Salmonella bacteria without damaging the functional properties of the products.

Studies, both USDA and contract, are being conducted on the freeze-drying -- including histological and biophysical changes in structure which are induced by the freezing and thawing of poultry muscle -- of raw and cooked poultry meat from several ages and species of poultry, including cut-up chicken parts and chicken in a comminuted form.

V CURRENT UTILIZATION RESEARCH PROGRAM

Present principal research areas -- including both domestic and foreign laboratories -- are as follows:

Cereal Grains and Forages. Major part of the research effort is devoted to corn and wheat, plus continuing investigations on rice, barley, oats, sorghum, and alfalfa and other forages. Present emphasis is upon development of:

Processes for chemically modifying starches, flours, and whole-grain cereals to make "cereal pulp" for use in paper products.

Dialdehyde starch derivatives, for use particularly in leather-tanning and plastics.

New and improved starch and flour derivatives for use in water-resistant adhesives and coatings, and foamed products.

Economic uses for high amylose starch chemicals and intermediates as textile sizings, protective films, and paper additives.

New food and industrial uses for wheat gluten.

Biological pesticides including insecticides for Japanese beetles, insect attractants, and plant antibiotics.

New and improved food uses for wheat, with increasing emphasis on products designed to meet specific needs of foreign markets.

New cereal products suitable for civilian emergency uses.

New and improved rice processing techniques and rice food products.

New and improved feed products, such as forage juice concentrates and air-classified products, and studies of biologically active constituents of forage products.

Cotton and Wool. Chemical, physical, and mechanical processing research on cotton and wool, and supporting fundamental and exploratory studies of their fiber properties and their modification. Program includes development of:

Stretch and bulky cotton products and processes.

Expanded uses for flame-retardant cotton products.

Improved wash-wear cotton fibers and fabrics.

Improved cotton batting products.

Chemical modifications of cotton to simultaneously impart durable water and oil repellency.

Weather- and rot-resistant finishes for cotton.

Improved cotton processing equipment for blending, for weaving, and for removing short fibers.

Easy-care wool processes (non-shrinking, permanent creases, etc.) for all types of woollen goods such as woven fabrics and knit goods.

New types of yarns and fabrics through physical and chemical modification of the coarser grades of domestic wools.

Chemically modified wool having improved resistance to damage by acids, alkalis, bleaching agents, heat, and light.

Fruits and Vegetables. Research to develop fruit and vegetable products that are attractive, economical, nutritive and meet the increasing demand for convenience-in-use, and to develop processes and equipment for manufacture of these products, including:

Commercial adaptation of the UR process for producing dehydrated sweetpotato flakes.

New dehydrated products, techniques, and facilities such as (a) foam-mat drying for fruit and vegetable juices, sauces, purees, and other products; and (b) dry-blanch-dry and puff-drying processes for producing fruit and vegetable products with superior reconstitution properties and high retention of original flavor and color characteristics.

Improved processes for freezing, dehydrofreezing, and dehydrocanning of fruit and vegetable products.

Investigations for improving texture, color, and stability of fermented vegetable products.

Studies to determine the processing qualities of new varieties of fruits, berries, and vegetables.

Oilseeds. Research primarily on soybean, cottonseed, and linseed oils, meals, and related products; investigations also include castor, tung, and selected oilseeds resulting from the new crops screening program. Research stresses new and broadened industrial uses, and seeks to improve food and feed uses. Investigations emphasize development of:

Processes to improve soybean oil for edible purposes; aldehyde acids and other derivatives of soybean oils for industrial uses; feed, food, and industrial uses for soybean meal and protein.

Processes and products utilizing chemically modified monoglycerides from vegetable oils, especially from cottonseed.

Linseed oil derivatives suitable for use in emulsion paints for exterior surfaces, in water-soluble paints, anti-spalling treatment of new concrete roads, and as industrial chemicals.

Industrial chemical derivatives, urethane foams, and animal feed meals from castorseed, plus basic and applied studies for removal of allergenic constituents.

Improved flavor, stability and nutritional properties of peanut-containing food products.

New industrial materials from tung oil, with special emphasis on uses in intumescent fire-protectant paints.

New and Special Plants. Investigations directed to develop compositional data on plants from world-wide sources in an effort to find alternate crops to fill needs not now met by domestic sources, and to develop new and more economic uses for domestic special plants. Includes:

Research on industrial utilization of new oilseeds, particularly on processing of erucic, epoxy, petroselenic, and hydroxyconjugated dienoic acid oils, and the development of chemical derivatives from these sources.

Research on new gum and pulping fiber plants, especially those containing mucilaginous materials and those suitable for use in paper, structural, and related products.

Chemical composition studies of tobacco and tobacco smoke to assist industry in its search for desired qualities in tobacco products.

Improvement of techniques for the processing of sugarcane, sugarbeet, and maple sap, and development of new uses for honey.

Development of new industrial chemicals from pine gum, turpentine, and rosin.

Poultry, Dairy and Animal Products. Development of better and more economic food products from milk, poultry, eggs, and meat, and development of new industrial outlets for fats, hides, and other animal byproducts. Research stresses development of:

Improved products made from meat and poultry, and better processing methods based upon fundamental studies of flavor, tenderness, microbiological activity, and time-temperature-tolerance stability.

New and improved milk products through studies of flavor stability; new concentrated and dried milk products; removal of radionuclides from milk products; and improved cheese-making technology.

New uses for animal fats in specialty synthetic detergents; as industrial chemical intermediates; and in polymers, plastics, resins, and lubricants.

Increased uses for animal hides stressing development of new techniques for unhairing, new processes for imparting improved resistance of leather to deterioration by heat and perspiration, and new and improved tanning procedures.

Dried egg products for use in dry mixes and other convenience foods; better methods for control of Salmonella in egg products.

VI FINANCIAL INFORMATION

The F. Y. 1963 and F. Y. 1964 domestic Utilization Research and Development funds under "Salaries and Expenses, Agricultural Research Service," including allotments from the Special Fund for additional labor, are as follows:

| | <u>F. Y. 1963</u> (Obligations) | <u>F. Y. 1964</u> (Estimated) |
|--|------------------------------------|----------------------------------|
| Cereal and forage crops | \$ 5,366,042 | \$ 5,483,800 |
| Cotton, wool and other fibers | 4,631,435 | 5,164,100 |
| Fruits and vegetables | 3,525,381 | 3,722,200 |
| Oilseeds | 2,982,995 | 3,146,500 |
| New and special plants | 2,043,632 | 2,043,200 |
| Poultry, dairy, and animal products .. | <u>5,361,321</u> | <u>5,532,300</u> |
| Total | <u>\$ 23,910,806</u> | <u>\$25,092,100</u> |

In F. Y. 1963 Congress provided an increase of \$4,975,000 which was distributed as follows:

| | | |
|--------------------------------------|----------------|--------------|
| <u>Cereal and forage crops</u> | | |
| Corn | \$ 540,000 | |
| Grain sorghum | 60,000 | |
| Wheat | 550,000 | |
| Forage | <u>50,000</u> | \$ 1,200,000 |
| <u>Cotton, wool and other fibers</u> | | |
| Cotton | \$ 750,000 | |
| Wool | <u>200,000</u> | \$ 950,000 |
| <u>Fruits and vegetables</u> | | |
| Fruits | \$ 375,000 | |
| Vegetables | <u>300,000</u> | \$ 675,000 |
| <u>Oilseeds</u> | | |
| Soybean | \$ 350,000 | |
| Flaxseed | 50,000 | |
| Cottonseed | 100,000 | |
| Peanut | 100,000 | |
| Castorbean | <u>50,000</u> | \$ 650,000 |
| <u>New and special plants</u> | | |
| New crops | \$ 100,000 | |
| Tobacco | <u>100,000</u> | \$ 200,000 |

| | | |
|---|----------------|---------------------|
| <u>Poultry, dairy and animal products</u> | | |
| Poultry products | \$ 200,000 | |
| Dairy products | 400,000 | |
| Meat products | 400,000 | |
| Hides and leather | 200,000 | |
| Animal fats (inedible) | <u>100,000</u> | <u>\$ 1,300,000</u> |
| Total F. Y. 1963 increase | | <u>\$ 4,975,000</u> |

In addition to the domestic Utilization Research and Development program, approximately \$2.14 million was obligated in F. Y. 1963 for utilization research projects, largely extending over a five-year period, in foreign laboratories financed by funds generated under the P. L. 480 program.

In F. Y. 1964, appropriations include an increase of \$200,000 for peanut quality research for the Southern Utilization Research and Development Division, New Orleans, Louisiana.

In addition, the 1964 Appropriation Act authorized the following additional items:

To be transferred from CCC funds:

| | |
|---|---------------------|
| Expanded utilization research | \$ 5,000,000 |
| Additional construction, including conversion of pilot plant, at Peoria Laboratory | 4,500,000 |
| Construction, alteration and equipment for the New Orleans, Albany, and Wyndmoor Laboratories, \$1,500,000 each | 4,500,000 |
| Enlarging and modernizing existing research facilities, \$250,000 each for Weslaco Fruit and Vegetable Laboratory, and Olustee Naval Stores Laboratory | 500,000 |
| Survey, determination of need, and planning of additional research facilities as may be required for utilization research in the Southeast, and weed control research, not to exceed (principally for utilization research facilities) | <u>250,000</u> |
| (Sub-total) | <u>\$14,750,000</u> |

Section 32 funds, also to be transferred from CCC:

| | |
|---|---------------------|
| Utilization research laboratory for Southeast ... | <u>9,500,000</u> |
| Total to be transferred | <u>\$24,250,000</u> |

VII SELECTED RESEARCH ACCOMPLISHMENTS

Cereal Derivatives for Strengthening Paper and Paperboard. Cationic dialdehyde starches have been developed by the Department's scientists that are excellent wet-end additives for increasing wet- and dry-strengths of paper without the use of retention aids as previously required with regular dialdehyde starch. Effective at low levels of application, they are less expensive to use than regular dialdehyde starch. This new development greatly improves the competitive position of dialdehyde starch as a wet-strength additive. With the laboratory work on cationic dialdehyde starch completed, increasing efforts are now being directed toward developing commercially successful processes for incorporating cereal xanthides in paper. Using the process developed by the Department, papers containing varying amounts of cereal xanthide have been successfully produced on a pilot-size paper machine. The water-insoluble cereal xanthides for this use are produced by treating flours, starches, or ground whole cereal grain with readily available, low-priced chemicals. Liner-board for corrugated paper boxes exhibits improved crush resistance under moist conditions -- a major deficiency in conventional corrugated boxes. Bag paper containing 20 percent cereal xanthide exhibits superior wet and dry strength. Other applications are being developed. Estimates indicate that the rapidly expanding paper products -- now producing over 38 million tons annually -- could utilize cereal xanthides requiring as much as 100 million bushels of cereal grains per year.

Enzymes Convert Corn and Sorghum to Inexpensive Carbohydrates for Industrial Fermentations. Sirups obtained by enzymatic treatment of corn or sorghum are attracting intense industrial interest as economical replacements for imported molasses used in industrial production of chemicals and antibiotics by fermentation. Steadily increasing prices and problems of availability are making molasses increasingly less attractive as a source of fermentable sugar. In the USDA process, starch in ground corn or sorghum is converted in high yield to glucose by a combination of bacterial and fungal amylases. The resulting sirup is an inexpensive source of fermentable carbohydrate. On a sugar basis, cost of the sirup from corn by this new process is estimated to be no higher -- and probably less -- than that for high-test molasses or for blackstrap. Adoption of the USDA process by the fermentation industry could lead to major expansion in the consumption of grain in this traditional market.

Process Discovered for Making Foamed Plastics from Starch. Rigid plastic foams have been made from starch by a simple process discovered by Department scientists. Key step in the process is the conversion of starch with inexpensive chemicals to liquid polyols that serve as an economical base for foam production by conventional methods. Color, density, dimensional stability, and other properties of the foams are within commercially acceptable ranges. The new products are being

evaluated to determine their potential in the rapidly expanding market for rigid foams which is expected to exceed 300 million pounds by 1965. Rigid foams are used for heat insulation alone or as part of a structural member. Another use is as an electrical insulator.

Cereal Derivative Contributed to Control Measures for Japanese Beetles.

Spores of milky disease bacteria induce a fatal disease in Japanese beetle grubs and thus provide the best nonchemical agent now known for control of this serious plant pest. Volume production of spores by industrially acceptable fermentation procedures would make this biological insecticide which leaves no dangerous residues and is harmless to man and animals, an economical material for general use. Department research has demonstrated the feasibility of growing milky disease bacteria on a large scale in the vegetative form by submerged culture fermentation on grain-based media. The next step in development of this control agent for the Japanese beetle is to obtain sporulation under industrially practicable conditions. So far, some success has been obtained in securing sporulation under industrially practicable conditions, but only on a solid medium. These and other studies are providing important new information on nutrients, bacterial metabolism, and previously unsuspected growth factors -- all essential to successful attainment of effective control measures. Work is continuing on all aspects of this important problem.

Modern Bulgur Process Preserves Nutrients. The new bulgur process developed by Department scientists, featuring continuous operation at atmospheric pressure, accomplished in commercially available equipment, preserves greater amounts of the heat-sensitive vitamins of wheat than the traditional open-pot boiling methods used for centuries in Near and Middle Eastern Countries. The new process is presently used for approximately 20 percent of the U. S. bulgur production -- now being produced at the rate of 600,000,000 pounds per year. High-temperature short-time soaking and cooking procedures retain from 75 to 95% of the major B-vitamins of the wheat kernel, an important dietary source of these factors. Preservation of high food values is particularly important in view of the use of bulgur in domestic and foreign school lunch programs and in growing export markets. Wide acceptance of bulgur abroad has resulted in a five-fold increase in overseas shipments during fiscal year 1963 compared to the preceding year.

Cooperative Studies Yield Improved Feeds. Cooperative Federal-State-Industry studies have demonstrated that dehydrated alfalfa meal can be produced which contains more than 5 times the normal amount of the plant estrogen coumestrol, and that these meals can increase growth rate of wether lambs by as much as 20 percent over control animals. Significant improvements in feed efficiencies were obtained. In addition, organoleptic tests of the meat conducted by trained taste panels showed significant differences in tenderness, juiciness, and texture, all in favor of the high coumestrol meals. These results should suggest that

the feed industry will eventually be able to produce "tailor-made" meals rich in coumestrol for increased rate of growth of meat animals and increased feed efficiency, a development which must await increased understanding of how to produce and harvest alfalfa with a high coumestrol content.

WURLAN Treatment of Wool Top. The WURLAN shrink-resistant treatment for wool fabrics developed by Department scientists is now in commercial use. Further Department research has recently demonstrated how wool may be WURLANized at the top stage, before it is spun into yarn. This development, now in the pilot plant stage, should make possible WURLANized knit goods. It is not feasible to treat knit goods directly because the loose open structure undergoes distortion during the manipulations that are successfully used to WURLANize woven fabric. The extension of the WURLAN process to wool top and thus to knit goods will help regain markets that have been dominated by synthetic products in recent years.

Improved Cotton Batting Now Undergoing Commercial Evaluation. Excellent chemically-treated cotton batts having improved dimensional stability, cohesiveness and resilience have been developed and produced experimentally on a pilot-plant scale by Department scientists in cooperative research with the National Cotton Batting Institute, Textile Waste Association, National Cottonseed Products Association, and the Foundation for Cotton Research and Education (affiliated with the National Cotton Council of America). Molded cotton batting products also have been made which appear promising for applications in head liners, bucket seats and crash pads in the automobile industry, and as padding in contoured furniture. These developments should make it possible for cotton batting to better meet the serious competition of polyurethane foams and foam rubber in padding applications and in mattresses. Two commercial plants have installed pilot lines for the production of the new cotton batting, and eight additional companies are contemplating the installation of pilot lines. Tests on auto seat cushions at two major automobile manufacturers have shown that the cotton batting at the present stage of development substantially meets their requirements for cushioning materials. Sample mattresses made with the batting are currently undergoing evaluation. These uses will broaden profitable outlets for byproducts from manufacture of cotton textiles and for cotton linters.

Commercialization of Stretch Cottons Advancing Rapidly. Consumer demand for stretch and bulked textiles in both wearing apparel and industrial applications is increasing rapidly. Research conducted by the Department on imparting stretch and bulkiness to cotton products using various chemical and mechanical processes is contributing significantly toward opening up new markets for cotton in this area. Reliable estimates place the potential for stretch cottons at a figure comparable to that of wash-wear fabrics which are now utilizing over a million bales of cotton annually. At least nine finishers in the United States are in commercial production of cotton stretch fabrics by one of the processes (slack

mercerization), and several other companies are preparing samples on a pilot-plant scale. Most of the production is going into apparel, but upholstery, slip cover material and coated fabrics are also being produced. Interest is also being shown in slack mercerized yarn for stretch knit goods. Two manufacturers of men's hose are producing experimental all-cotton stretch hose by slack mercerizing a very loosely knit hose. A number of companies are also investigating the possibility of producing cotton stretch products by several other approaches studied by Department researchers.

SRRL Non-Lint Tester Being Produced Commercially. The SRRL Non-Lint Tester, a Department-developed machine for rapidly determining the "non-lint" or trash content of lint cotton, was released to the cotton industry in October 1962. Two companies are currently producing the Tester, and four additional companies are licensed to manufacture it. Manufacturers report keen interest by the textile industry and an immediate potential sale of at least 40 machines. With this Tester -- a tool long needed by the cotton industry -- trash content of a bale of cotton can be determined in about 2 minutes, as compared with 20 minutes for conventional equipment. The Tester has been evaluated by ARS and AMS on over 1100 cottons, representing a wide range of grades and qualities, with excellent results. It will help manufacturers produce higher quality cotton products by aiding in selecting cottons of optimum cleanliness for specific end-products and in adjusting cleaning equipment for maximum efficiency. It also will be of value in research to develop more efficient cotton gin and textile mill cleaning equipment.

Basic Information Developed on the Burning of Cotton Textiles. Reduced flammability of cotton textiles for apparel, draperies, awnings, and other items, is highly desirable from the standpoint of safety. The nature of the reactions involved in the burning of cotton -- never understood from a technical standpoint -- are being studied under a P. L. 480 grant of funds to The Cotton, Silk, and Man-Made Fibers Research Association, Shirley Institute, Manchester, England. It has been found that the tars and gases formed when cotton is heated to burning temperature are sufficiently rich in oxygen to burn with little access to air, hence the well known flammability of cotton fabrics. This knowledge indicates that fabric finishes designed to reduce the flammability of cotton should be directed toward preventing the formation of combustible products. Permanent flame-proofing finishes for cotton that have been successfully developed in the Department have been shown to function in this manner.

Commercial Production of "Instant" Sweetpotato Flakes Increasing. The number of commercial firms producing precooked, dehydrated sweetpotato flakes -- a product developed by Department researchers in cooperation with the Quartermaster Food and Container Institute for the Armed Forces -- continues to increase. Two plants are commercially producing

the "instant" flake product at the present time, and plans for installation of a third plant have been announced. The plant which initially produced flakes in the 1961-62 season has more than doubled its production for the 1962-63 season. Institutional market tests conducted in cooperation with Economic Research Service and others have indicated a highly favorable reaction to the new product by management, cooks and chefs, and consumers in various institutional outlets. Although the flakes are presently going to institutional markets, steps are being taken in continuing Department research to assist in initiating household retail markets for the product. The flakes are opening profitable new markets, potentially 6 to 8 million bushels, especially for the sub-standard (odd sized and shaped) sweetpotatoes which now return little or no income to the farmer, and for the standard grades not adequately absorbed by the demand for fresh, canned and frozen products.

Outlets for Apples Increased by Utilization Research. A commercial installation using a process based on ARS research is scheduled to begin operation in the latter part of 1963. The factory is now being installed by a growers cooperative. The new product is a 4-fold frozen apple juice concentrate with restored aroma. Plant capacity will utilize approximately 3 million bushels of apples annually. Apples for this use should yield the grower significantly more returns than apples used in making the single-strength juice.

New Date Tenderizing Process. Dates are tenderized by a new process developed by Department scientists in studies that were partially supported by industry funds. The process requires no new packing house equipment and has overcome a long-standing problem of the domestic date industry. It is now in use for essentially all of that portion (about 50 percent) of the U. S. crop which normally fails to ripen to top quality and lacks a soft smooth texture. The new process involves a heat activation of natural date enzymes that convert sugar in the dates to invert sugar. The conversion causes a pronounced tenderizing and decreases the tendency of dates to dry out during storage. The treated dates maintain their softness at low moisture levels and are, therefore, especially suitable for manufacture of new date and cereal products as in breakfast foods and baking mixes. Solution of the date texture problem thus broadens domestic markets and places U. S. dates in a stronger competitive position for world markets.

New Dried Fruit Preservation Method. High-moisture dried fruits are now extensively preserved with sorbates as the result of cooperative research by Department and California Experiment Station scientists, partially supported by industry funds. In recent years there has been an increased consumer demand for high-moisture products because they are more tender and palatable when eaten "out-of-hand", and can be cooked rapidly without prolonged simmering. Because high-moisture dried fruits are susceptible to mold and yeast spoilage, some type of antimycotic

treatment is necessary. Sorbates were found to be highly satisfactory for this purpose and conditions for their use were developed. Sorbates do not evaporate even after the package is opened and are effective until the fruit is eaten. Within two years of discovery, the new treatment achieved wide-spread acceptance, as indicated by the scale of commercial use. Nearly all high-moisture dried prunes and over 50% of the dried figs for market are now treated with sorbates.

Controlling Non-Enzymic Browning in Dehydrated Vegetables. Without adequate protection, dehydrated fruits and vegetables will gradually become brown in color, develop objectionable flavors and odors, and suffer losses in vitamins and nutritive value. While the most common way to avoid these effects has been to treat the products with sulfur dioxide during processing, until recently very little has been known about the mechanism of this protective treatment. Under a P. L. 480 project in London, England the mechanism of the browning reaction between sugars and amino acids, has been greatly clarified. It has been shown that this type of non-enzymic browning involves the formation of a particular type of unsaturated aldehyde. By combining with this aldehyde, sulfur dioxide prevents its further reaction with amino compounds to produce brown-colored products. This new fundamental knowledge provides a basis for developing new methods for protecting fruits and vegetables from non-enzymic browning.

New Protein Food for Developing Countries. Cooperative studies between the Department, United Nations International Children's Emergency Fund (UNICEF), and industry have resulted in development of a simple, direct process for converting soybeans to full-fat soy flour, a nutritious protein-rich food. The process lends itself to the development of a compact truck- or trailer-mounted plant -- using commercially available equipment -- to process food for children in developing countries where large-scale industry is not yet feasible. Preliminary estimates indicate processing cost of less than one cent per pound of product. Experimental lots involving several tons have been produced. The product has passed laboratory and animal feeding tests in this country, and UNICEF has made shipments to Taiwan and Indonesia for testing in children feeding programs.

U. S. Soybeans Found Superior to Japanese Beans for Soy Sauce. Results from commercial production tests have shown that the protein from certain varieties of U. S.-grown soybeans is more easily utilized in the production of soy sauce than that from Japanese-grown soybeans. This important advantage was determined by experiments conducted under the supervision of the Japanese Soy Sauce Research Institute in 13 different, widely separated commercial plants in Japan. Since about 12 million bushels of soybeans are consumed annually in Japan for making soy sauce, the Institute's findings are especially significant for the U. S. export market. This research was conducted under a P. L. 480 contract.

Improved Flavor of Soybean Oil. Based on previous research of the Department that showed linolenic acid to be the principal cause of flavor instability of soybean oil, the industry introduced a process for its removal by hydrogenation followed by winterization to remove high-melting saturated and trans acids. Oils so processed have significantly improved stability, but for economic reasons it is important to recover as much liquid oil as possible. Further Department research has shown how the yield of soybean oil with enhanced flavor stability can be increased in the hydrogenation-winterization process. In addition, the stearine fraction of soybean oil is upgraded and can be more readily marketed. Although hydrogenation-winterization is not a complete answer to the flavor problem of liquid soybean oil, it is a practical procedure that contributed significantly to increased use of soybean oil for salad and cooking purposes. A number of commercial processors are showing high interest in this new development.

Castor Seed Research Leads to Test for Human Allergies. The full commercial utilization of castor seed requires new knowledge on how to overcome its allergy-inducing characteristics. In the past, measurement of castor allergy required the dangerous and costly use of human volunteers, involving two major risks: (1) the subject may suffer serious anaphylactic reaction to the test allergen or, (2) the subject may become sensitized to substances he would not otherwise have encountered. Department scientists recently have developed a test procedure that uses laboratory animals rather than human subjects. The new test provides a basis for solving many problems caused by allergen sensitivity to castor and other agricultural products. Beyond this immediate objective, the new test has implications in a broad range of scientific research, including physiology, medicine and phylogenetic investigations.

Use Potential of Crambe Increased. Research on erucic acid, the principal fatty acid of crambe oil, and on processing crambe seed to produce palatable nutritious feed meal, has substantially increased the use-potential for this new oilseed now under development in the Department's new crops research program. The practicability of conversion of erucic acid to dibasic brassylic acid in good yield and purity has been demonstrated and promising results have been obtained in study and evaluation of this dibasic acid in several industrial end-uses. Concurrent studies on processing crambe seed to oil and meal have revealed significant new information on biologically important components of the meal and have provided the basis for new techniques for obtaining feed meal with acceptable nutritional qualities. Department research has shown that crambe, a plant related to rape and mustard, has excellent crop potential and gives satisfactorily high yields under dry-farming and irrigation conditions. It can be grown in place of crops now in overabundant supply and in areas where there is no locally grown oilseed meal crop. Crambe oil would compete with imported rapeseed oil but not with presently grown domestic vegetable oils.

Sugar Beet Utilization Research Leads to Test for Diagnosing Infant Disease. Through research directed to the identification of substances that decrease the recovery of sugar from sugar beets, a discovery was made that will save the lives of many children afflicted with galactosemia. This disease occurs in babies born without the ability to metabolize the sugar galactose, and causes jaundice, liver damage, cataracts, and mental deficiency. It can be successfully treated only when detected within a few days after birth. Treatment consists of diet regulation to avoid use of foods containing galactose. In the present studies, galactose was identified as an interfering substance in sugar beet processing, and a test for its presence developed. Not only is this newly-developed galactose test used for diagnosis of galactosemia, but also is used for checking foods for galactose, so that a safe diet can be prescribed.

New Information Obtained on Tobacco and Tobacco Smoke Composition. As a result of ARS research, new information on the constituents of tobacco and its combustion products that influence the flavor and aroma of tobacco smoke has been obtained. Major differences in the amounts and distribution of certain kinds of organic acids were found in the four principal cigarette tobacco types. Turkish and bright tobaccos were found to contain larger amounts of the acids than burley and Maryland types. Distinct differences in the acid pattern of the former two tobaccos and between "aromatic" and "aroma-deficient" grades of bright tobaccos were also detected. The volatile neutral components of cigarette tobaccos and smoke were less distinguishing with regard to tobacco types. These results illustrate the kind of basic information that will lead to a more complete understanding of the part the chemical components of leaf tobacco play in the flavor and aroma of the smoke and that will serve as a basis for improving tobacco products.

Bacteriological Quality of Chilled and Frozen Foods. A comprehensive collation of information on low temperature microbiology has produced within the Department an authoritative repository of knowledge on bacteriological safety and quality in chilled and frozen foods. That portion of the work now published has already proved invaluable to public health officials at the local, national, and international levels who have used it as a scientific basis for discussions on and development of microbiological standards for chilled and frozen foods. This work has created a clear delineation between microbial problems which endanger the health of the consumer and those which cause non-hazardous but costly losses in food product quality. In addition, it has provided research workers both in and out of government a firm basis for further research to improve the technology of food handling and processing.

Quality of Frozen Fried Chicken Improved. The freezing and subsequent reheating of fried chicken for serving, increases the tendency of usual coating materials to peel off and become unattractive. This defect has been overcome by Department food scientists. It was found that a coating

that adheres to the meat even after freezing, thawing, and reheating, can be obtained by partial cooking to shrink the meat before application of the batter. Both shrinkage of the meat during cooking and the pressure of escaping moisture tend to cause loosened coatings. In addition to a method for improving adhesion of the coating, the research has shown how batter ingredients can be varied to obtain desired thickness, crispness, color and attractive appearance of the coating. The results can be applied by processors to develop a variety of formulated coatings that will provide the adhesive quality, thickness, appearance, and consistency needed to increase the value of this convenience product in various markets.

New Method Developed for Preparing Potentially Valuable Fat Compound.

A new method for preparing gamma-stearolactone, a potentially valuable fat-based compound, has been developed from ARS research. While this compound has been known for many years, methods for its preparation were tedious and the yields obtained were low, so that it offered little potential as a low-cost chemical intermediate. By the new procedure it can be prepared readily from oleic acid (an important component of animal fats) in high yield and purity and should be competitive with other materials used in this field. No special equipment needs are anticipated for its manufacture. Because of its high order of reactivity, gamma-stearolactone should prove useful in the polymer, lubricant and plasticizer fields. It is planned also to investigate this compound as a reactive intermediate for preparing other potentially valuable compounds.

Cost of Manufacturing Non-Fat Dry Milks Reduced. A new process for non-fat milk, developed from ARS research, produces an instant type dry milk powder with an appreciable reduction in the cost of manufacture. Development of foam spray drying, and in cooperation with industry, of new vacuum concentrators, is making possible the removal of more water in the concentrator than heretofore, thus leaving less to be vaporized in the atmospheric dryer. The new process, which can be done in commercially available equipment, reduces costs and substantially increases dryer capacity. Widespread interest in the Department's novel process is being shown by manufacturers of dry milks and equipment manufacturers.

Shelf Life of Improved Evaporated Milk Extended. The "cooked" flavor of ordinary evaporated milk now found objectionable by consumers can be reduced by using high temperature-short time sterilization to produce an improved evaporated milk. However, products made by using this new technique gel rapidly during storage. As a result of ARS research, it has been found that addition of polyphosphates to the milk prior to processing markedly reduces the rate of gelation. The use of polyphosphates in lieu of current additives can be done in the usual high temperature-short time facilities at no anticipated increase in costs. The principal producers of evaporated milk in this country are now testing the commercial applicability of this discovery.

Enzymes Involved in Meat Tenderizing Studied. Basic research under a P. L. 480 grant conducted by The Low Temperature Research Station at Cambridge, England, has given a better understanding of the reaction of meat-tenderizing enzymes on muscle proteins. A new mucoprotein has been discovered that is intimately associated with the elastin in certain elastic tissues and has a protective effect on these fibers. This protective effect of the protein requires the combined action of two enzymes, mucolytic and elastolytic, to dissolve the elastic fibers of meat tissue. It was also found that connective tissues vary in different parts of the animal, accounting for the variable reaction to meat tenderizers. A new enzyme isolated from a pathogenic organism in salmon is very active at low temperatures and may have a future usefulness in meat tenderization. These new fundamental findings will aid in developing improved meat tenderizing compounds and procedures.

